Apprenticeship and Industry Training

Boilermaker

Apprenticeship Course Outline

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Boilermaker
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Apprenticeship

Apprenticeship is post-secondary education with a difference. Apprenticeship begins with finding an employer. Employers hire apprentices, pay their wages and provide on-the-job training and work experience. Approximately 80 per cent of an apprentice's time is spent on the job under the supervision of a certified journeyperson or qualified tradesperson. The other 20 per cent involves technical training provided at, or through, a post-secondary institution – usually a college or technical institute.

To become certified journeypersons, apprentices must learn theory and skills, and they must pass examinations. Requirements for certification—including the content and delivery of technical training—are developed and updated by the Alberta Apprenticeship and Industry Training Board on the recommendation of Boilermaker Provincial Apprenticeship Committee.

The graduate of the Boilermaker apprenticeship program is a certified journeyperson who will be able to:

- understand the principles of drafting; how drawings originate, their purpose and how to correctly interpret the information therein
- understand the use of each type of drawing, part work order sketches, materials lists and specification sheets
- layout from drawings to material; pattern development and template making
- relate to all applicable Codes and Regulations with reference to materials specifications, uses and safety for vessels of all types and the acceptable methods of construction for pressure vessels
- relate to metallurgy, structural shapes, plate, pipe and pipe fittings with respect to vessel components, ropes, wire and fibre types, uses of pipe and its respective fittings and materials used with pressure vessels, both metallic and non-metallic
- use hand tools and powered equipment in a proper and safe manner
- calculate material quantities
- perform a satisfactory operation with oxyfuel or electric arc welding equipment in order to facilitate this work
- relate to the work of other tradespeople in affiliated trades
- perform assigned tasks in accordance with quality and production standards required by industry

Apprenticeship and Industry Training System

Industry-Driven

Alberta's apprenticeship and industry training system is an industry-driven system that ensures a highly skilled, internationally competitive workforce in more than 50 designated trades and occupations. This workforce supports the economic progress of Alberta and its competitive role in the global market. Industry (employers and employees) establishes training and certification standards and provides direction to the system through an industry committee network and the Alberta Apprenticeship and Industry Training Board. The Alberta government provides the legislative framework and administrative support for the apprenticeship and industry training system.

Alberta Apprenticeship and Industry Training Board

The Alberta Apprenticeship and Industry Training Board provides a leadership role in developing Alberta's highly skilled and trained workforce. The board's primary responsibility is to establish the standards and requirements for training and certification in programs under the Apprenticeship and Industry Training Act. The board also provides advice to the Minister of Advanced Education and Technology on the needs of Alberta's labour market for skilled and trained workers, and the designation of trades and occupations.

The thirteen-member board consists of a chair, eight members representing trades and four members representing other industries. There are equal numbers of employer and employee representatives.

Industry Committee Network

Alberta's apprenticeship and industry training system relies on a network of industry committees, including local and provincial apprenticeship committees in the designated trades, and occupational committees in the designated occupations. The network also includes other committees such as provisional committees that are established before the designation of a new trade or occupation comes into effect. All trade committees are composed of equal numbers of employer and employee representatives. The industry committee network is the foundation of Alberta's apprenticeship and industry training system.

Local Apprenticeship Committees (LAC)

Wherever there is activity in a trade, the board can set up a local apprenticeship committee. The board appoints equal numbers of employee and employer representatives for terms of up to three years. The committee appoints a member as presiding officer. Local apprenticeship committees:

- monitor apprenticeship programs and the progress of apprentices in their trade, at the local level
- make recommendations to their trade's provincial apprenticeship committee (PAC) about apprenticeship and certification in their trade
- promote apprenticeship programs and training and the pursuit of careers in their trade
- make recommendations to the board about the appointment of members to their trade's PAC
- help settle certain kinds of disagreements between apprentices and their employers
- carry out functions assigned by their trade's PAC or the board

Provincial Apprenticeship Committees (PAC)

The board establishes a provincial apprenticeship committee for each trade. It appoints an equal number of employer and employee representatives, and, on the PAC's recommendation, a presiding officer - each for a maximum of two terms of up to three years. Most PACs have nine members but can have as many as twenty-one. Provincial apprenticeship committees:

- Make recommendations to the board about:
    - standards and requirements for training and certification in their trade
    - courses and examinations in their trade
    - apprenticeship and certification
    - designation of trades and occupations
    - regulations and orders under the Apprenticeship and Industry Training Act
- monitor the activities of local apprenticeship committees in their trade
- determine whether training of various kinds is equivalent to training provided in an apprenticeship program in their trade
- promote apprenticeship programs and training and the pursuit of careers in their trade
- consult with other committees under the Apprenticeship and Industry Training Act about apprenticeship programs, training and certification and facilitate cooperation between different trades and occupations
- consult with organizations, associations and people who have an interest in their trade and with employers and employees in their trade
- may participate in resolving certain disagreements between employers and employees
- carry out functions assigned by the board

Boilermaker PAC Members at the Time of Publication

Mr. C. Booth	Edmonton	Presiding Officer
Mr. T. Arthurs	Calgary	Employer
Mr. J. Evans	Edmonton	Employer
Mr. G. Jacobs	Devon	Employer
Ms. K. Jones	Carvel	Employer
Ms. J. Holroyd	Tofield	Employee
Mr. D. Schumph	Edmonton	Employee
Mr. J. Mazur	Edmonton	Employee
Mr. D. Ralph	Calgary	Employee

Alberta Government

Alberta Advanced Education and Technology works with industry, employer and employee organizations and technical training providers to:

- facilitate industry's development and maintenance of training and certification standards
- provide registration and counselling services to apprentices and employers
- coordinate technical training in collaboration with training providers
- certify apprentices and others who meet industry standards

Technical Institutes and Colleges

The technical institutes and colleges are key participants in Alberta's apprenticeship and industry training system. They work with the board, industry committees and Alberta Advanced Education and Technology to enhance access and responsiveness to industry needs through the delivery of the technical training component of apprenticeship programs. They develop lesson plans from the course outlines established by industry and provide technical training to apprentices.

Apprenticeship Safety

Safe working procedures and conditions, incident/injury prevention, and the preservation of health are of primary importance in apprenticeship programs in Alberta. These responsibilities are shared and require the joint efforts of government, employers, employees, apprentices and the public. Therefore, it is imperative that all parties are aware of circumstances that may lead to injury or harm.

Safe learning experiences and healthy environments can be created by controlling the variables and behaviours that may contribute to or cause an incident or injury. By practicing a safe and healthy attitude, everyone can enjoy the benefit of an incident and injury free environment.

Alberta Apprenticeship and Industry Training Board Safety Policy

The Alberta Apprenticeship and Industry Training Board fully supports safe learning and working environments and encourages the teaching of proper safety procedures both within trade specific training and in the workplace.

Trade specific safety training is an integral component of technical training, while ongoing or general non-trade specific safety training remains the responsibility of the employer and the employee as required under workplace health and safety legislation.

Workplace Responsibilities

The employer is responsible for:

- training employees and apprentices in the safe use and operation of equipment
- providing and maintaining safety equipment, protective devices and clothing
- enforcing safe working procedures
- providing safeguards for machinery, equipment and tools
- observing all accident prevention regulations

The employee and apprentice are responsible for:

- working in accordance with the safety regulations pertaining to the job environment
- working in such a way as not to endanger themselves, fellow employees or apprentices

Workplace Health and Safety

A tradesperson is often exposed to more hazards than any other person in the work force and therefore should be familiar with and apply the Occupational Health and Safety Act, Regulations and Code when dealing with personal safety and the special safety rules that apply to all daily tasks.

Workplace Health and Safety (Alberta Employment, Immigration and Industry) conducts periodic inspections of workplaces to ensure that safety regulations for industry are being observed.

Additional information is available at www.worksafely.org

Technical Training

Apprenticeship technical training is delivered by the technical institutes and many colleges in the public post-secondary system throughout Alberta. The colleges and institutes are committed to delivering the technical training component of Alberta apprenticeship programs in a safe, efficient and effective manner. All training providers place great emphasis on safe technical practices that complement safe workplace practices and help to develop a skilled, safe workforce.

The following institutions deliver Boilermaker apprenticeship technical training:

Northern Institute of Technology (Souch Campus)

Procedures for Recommending Revisions to the Course Outline

Advanced Education and Technology has prepared this course outline in partnership with the Boilermaker Provincial Apprenticeship Committee.

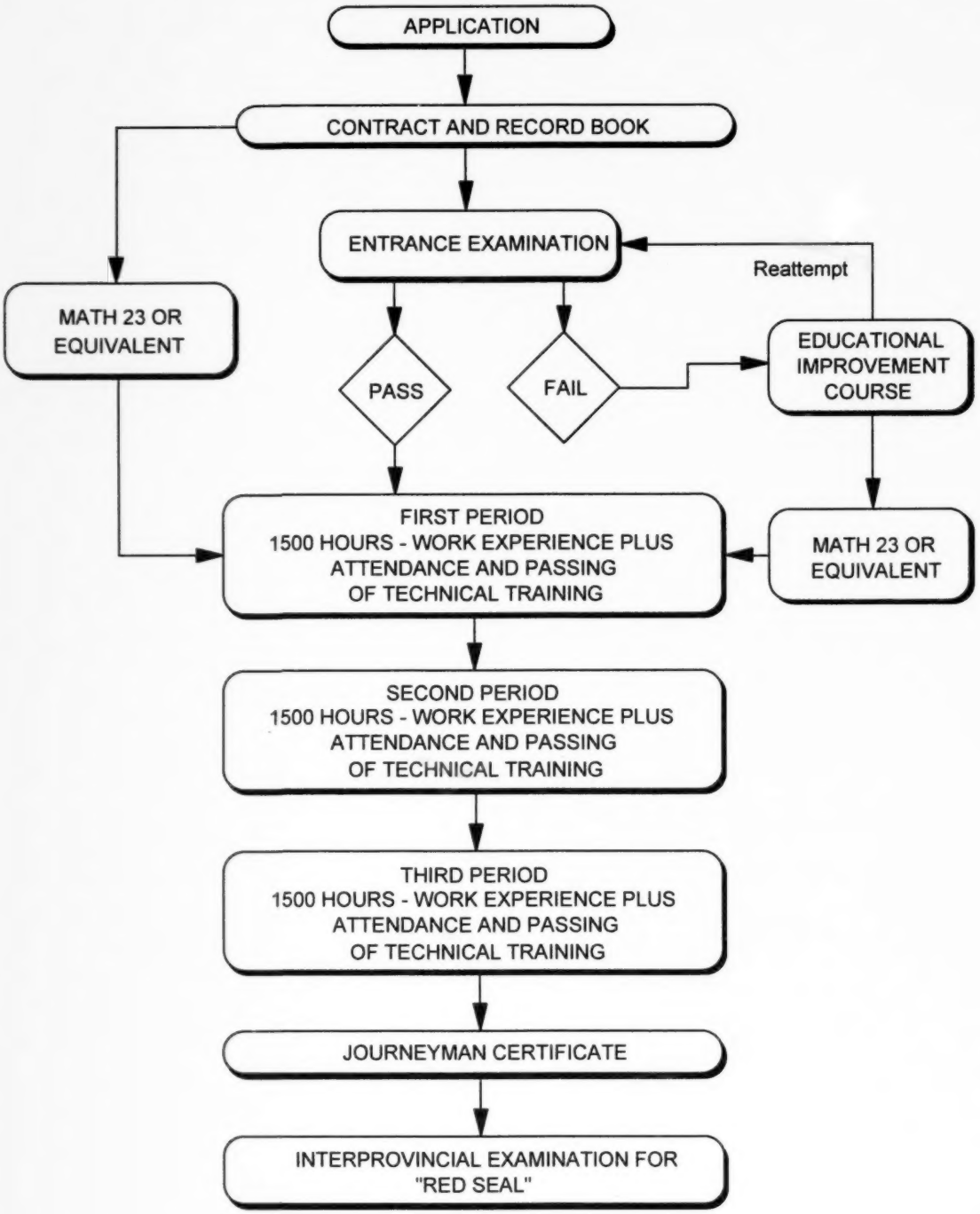
This course outline was approved on May 15, 2009 by the Alberta Apprenticeship and Industry Training Board on a recommendation from the Provincial Apprenticeship Committee. The valuable input provided by representatives of industry and the institutions that provide the technical training is acknowledged.

Any concerned individual or group in the province of Alberta may make recommendations for change by writing to:

Boilermaker Provincial Apprenticeship Committee
c/o Industry Programs and Standards
Apprenticeship and Industry Training
Advanced Education and Technology
10th floor, Commerce Place
10155 102 Street NW
Edmonton AB T5J 4L5

It is requested that recommendations for change refer to specific areas and state references used. Recommendations for change will be placed on the agenda for regular meetings of the Boilermaker Provincial Apprenticeship Committee.

Apprenticeship Route toward Certification


APPLICATION
CONTRACT AND RECORD BOOK
ENTRANCE EXAMINATION
Reattempt
MATH 23 OR EQUIVALENT
PASS
FAIL
EDUCATIONAL IMPROVEMENT COURSE
FIRST PERIOD
1500 HOURS - WORK EXPERIENCE PLUS ATTENDANCE AND PASSING OF TECHNICAL TRAINING
MATH 23 OR EQUIVALENT
SECOND PERIOD
1500 HOURS - WORK EXPERIENCE PLUS ATTENDANCE AND PASSING OF TECHNICAL TRAINING
THIRD PERIOD
1500 HOURS - WORK EXPERIENCE PLUS ATTENDANCE AND PASSING OF TECHNICAL TRAINING
JOURNEYMAN CERTIFICATE
INTERPROVINCIAL EXAMINATION FOR "RED SEAL"

Boilermaker Training Profile

FIRST YEAR
(8 Weeks 30 Hours per Week – Total of 240 Hours)

SECTION ONE

GENERAL SAFETY — **32 HOURS**

- **A** — Common Hazards — 14 Hours
- **B** — Proper Use of Safety Equipment — 3 Hours
- **C** — Workers' Compensation Board — 1 Hour
- **D** — Interpersonal and Essential Skills — 6 Hours
- **E** — Emergency First Aid and C.P.R. — 8 Hours

SECTION TWO

RIGGING ONE — **40 HOURS**

- **A** — Ropes — 18 Hours
- **B** — Hoisting Devices and Accessories — 8 Hours
- **C** — Hoisting Communication (Signals) — 4 Hours
- **D** — Wire Rope and Attachments — 10 Hours

SECTION THREE

INTRODUCTION TO DRAWINGS AND LAYOUT — **58 HOURS**

- **A** — Basic Materials — 12 Hours
- **B** — Materials Preparation and Assembly — 8 Hours
- **C** — Basic Drafting — 20 Hours
- **D** — Introduction to Layout — 18 Hours

SECTION FOUR

WELDING AND CUTTING — **50 HOURS**

- **A** — Electric Arc Welding — 25 Hours
- **B** — Oxy-fuel Cutting — 25 Hours

SECTION FIVE

TRADE KNOWLEDGE ONE — **60 HOURS**

- **A** — Mathematics — 20 Hours
- **B** — Hand and Power Tools — 16 Hours
- **C** — Metallurgy — 8 Hours
- **D** — Trade Related Components — 10 Hours
- **E** — Identification of Pressure Vessels — 8 Hours

SECOND YEAR
(8 Weeks 30 Hours per Week – Total of 240 Hours)

SECTION ONE

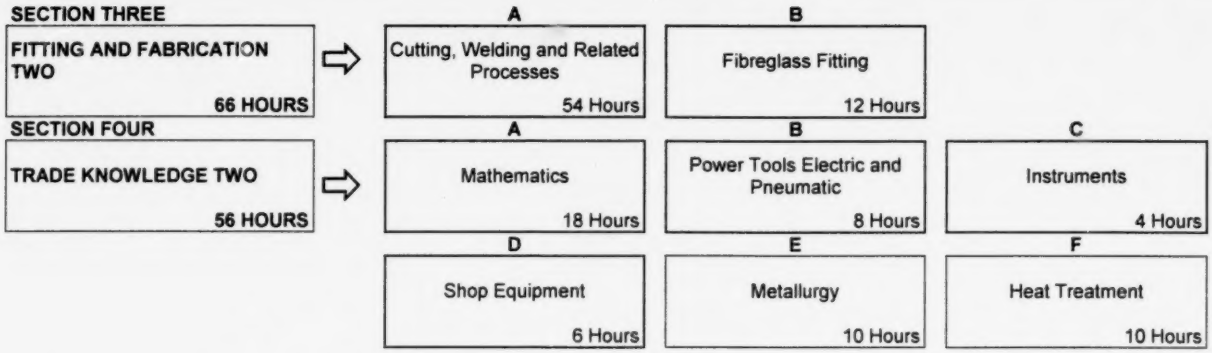
RIGGING TWO — **52 HOURS**

- **A** — Block and Tackle Two — 20 Hours
- **B** — Wire Rope Drums — 5 Hours
- **C** — Lifting Practices — 20 Hours
- **D** — Aerial Access Equipment and Scaffolds — 6 Hours

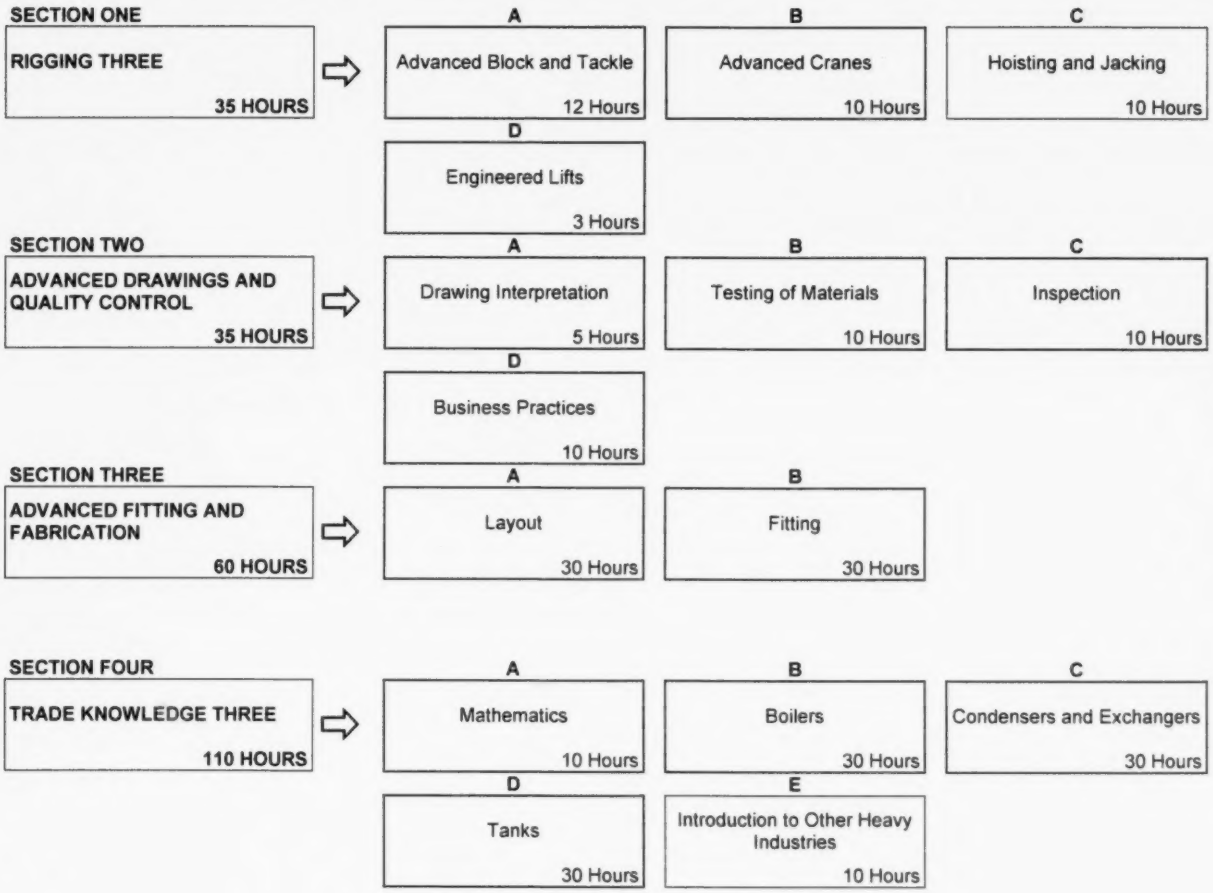
SECTION TWO

DRAWINGS AND LAYOUT — **66 HOURS**

- **A** — Drawing Interpretation — 24 Hours
- **B** — Layout and Fabricating — 42 Hours



THIRD YEAR
(8 Weeks 30 Hours per Week – Total of 240 Hours)



NOTE: The hours stated are for guidance and should be adhered to as closely as possible. However, adjustments must be made for rate of apprentice learning, statutory holidays, registration and examinations for the training establishment and Apprenticeship and Industry Training.

FIRST YEAR TECHNICAL TRAINING
BOILERMAKER TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

SECTION ONE: .....GENERAL SAFETY..... 32 HOURS

This section presents information on accident prevention, first aid, the operation of fire fighting equipment and Workplace Hazardous Material Information System (W.H.M.I.S.).
The safety subject matter taught in this section must also be stressed in the appropriate sections throughout the Boilermaker training program. Reference should be made to OH&S when applicable.

A. Common Hazards .....14 Hours

Outcome: ***Recognize and apply safe working procedures and practices.***

1. Demonstrate knowledge of workplace hazards.
   - a) Recognize and correct common causes of accidents in the work environment
   - b) Carry out work activities in a manner conductive to a maximum possible standard of shop safety
   - c) Recognize, report and/or eliminate fire hazards existing in the work environment
   - d) Recognize various classes of fires and be aware of the extinguishing medium for use in each case
   - e) Effectively operate fire-extinguishing equipment to extinguish various classes of fires
   - f) Demonstrate knowledge of the fall restraint, fall arrest program.
   - g) Complete a Job Safety Analysis (JSA'S).
2. Identify potential fatal hazards in confined space entry.
   - a) entering without testing
   - b) lack of retesting
   - c) not blanking or locking out
   - d) lack of ventilation
   - e) inert gases
   - f) use of oxygen
   - g) cutting /welding hoses and valves
   - h) welding without checking neighboring compartments
   - i) sludge in confined space
   - j) lack of respiratory protection
   - k) possible toxic or flammable material
   - l) improper rescue procedures
3. Locate and identify legislation and regulations pertinent to "confined space entry".
   - a) definition of confined space
   - b) employer's responsibilities
   - c) employee's responsibilities
   - d) code of practice for entry and work in confined spaces
   - e) safety training
4. Describe the following hazards in confined space entry.
   - a) enclosed spaces
   - b) partially enclosed spaces

c) natural ventilation
d) oxygen deficiency
e) explosive and toxic liquids and gases
f) hydrogen sulfide
g) carbon monoxide
h) liquid materials
i) decaying organic matter in confined space
j) fire triangle
k) lower and upper explosive limits

5. Preplan confined space entry.

a) atmospheric testing and monitoring
b) procedures
c) preparations
d) safety equipment and clothing
e) ground fault interrupters
f) explosion proof lighting
g) intrinsic safety
h) rescue equipment

6. Identify and describe a permit system for confined space entry

7. Define and describe what is meant by a W.H.M.I.S. label and distinguish between supplier and workplace labels and other means of identification.

8. Describe what is meant by the following W.H.M.I.S. classifications:

a) prohibited product
b) restricted product
c) controlled product

9. Explain what a Material Safety Data Sheet (M.S.D.S.) is, its purpose and limitations.

10. Describe the roles and responsibilities of employer, supplier and worker of W.H.M.I.S. in the education of workers and other subject areas as deemed appropriate and deliverable by the training establishments.

11. Demonstrate the safe use and operation of all equipment and supplies as indicated by manufacturers' specifications or specifications certified by an engineer.

B. Proper Use of Safety Equipment ..... 3 Hours

Outcome: Identify and demonstrate the proper use of safety equipment.

1. Demonstrate the proper use of the following safety equipment:
   a) welding helmets
   b) boots
   c) glasses
   d) goggles/shields
   e) safety harness
   f) clothing
   g) dust filters / respirators
   h) fresh air breathing equipment
   i) air movers
   j) safety showers / eyewash stations
   k) fire fighting equipment
   l) hearing protection equipment
   m) head protection
   n) ladders

C. Workers' Compensation Board (W.C.B.) ..... 1 Hour

It is understood that the W.C.B. is a generic term referring to the provincial governing authority.

Outcome: Describe the Workers' Compensation Board regulations.

1. Interpret and define Workers' Compensation Board regulations.
2. Complete and remit the appropriate forms as may be required by the W.C.B.
   a) form to be completed
   b) methods of completing
   c) where to remit

D. Interpersonal and Essentials Skills ..... 6 Hours

Outcome: Recognize and apply interpersonal and essential skills.

1. Demonstrate the ability to use interpersonal and essential skills to communicate and interact with others.
   a) apprentices
   b) the public
   c) fellow workers
   d) supervisory personnel (foreman and employer)
   e) contractor and owner representatives
   f) other trades people
   g) provincial government departments
   h) the unions
2. Identify and describe good public relations with other trades as well as problems and public needs.
   a) cooperation with allied trades
   b) coordination with other trade functions
   c) recognition of problems in all phases

d) consideration of public needs

3. Describe the apprenticeship training system in Alberta.

a) Identify the training profile of a Boilermaker Apprentice in Alberta.
b) Describe the responsibilities for the Contract of Apprenticeship by the apprentice, employer and Alberta Apprenticeship and Industry Training.
c) Discuss the contents of the apprenticeship training record book

E. Emergency First Aid and C.P.R. ..... 8 Hours

Outcome ***Administer immediate on the spot first aid to persons with minor injuries and administer temporary emergency first aid to the more seriously injured, as deemed adequate until qualified medical personnel are available.***

1. Explain the responsibilities and duties of the first aid person.
2. Explain the diagnoses for:

a) respiratory failure
b) burns
c) body injury

3. Applying artificial respiration:

a) explain the process of freeing the victim of breathing restrictions
b) explain the process of applying mouth-to-mouth respiration

4. Describe the emergency treatment procedure for:

a) assessing injury
b) moving the patient
c) arresting bleeding
d) completing Workers' Compensation Board forms

5. Explain the methods of treating various burns and quenching a fire on a victim.
6. Basic C.P.R.

SECTION TWO: RIGGING ..... 40 HOURS

A. Ropes ..... 18 Hours

Outcome: ***Apply safe work practices and procedures when using ropes.***

1. Define and describe fibre and synthetic ropes

a) Define the construction
b) Describe grades and applications
c) Explain best practices for the of care and handling of ropes.

2. Define and describe working load limits (W.L.L.) formulas, factors and reductions for natural and synthetic ropes
3. Identify the purpose and demonstrate the ability to tie the following knots and hitches:

a) bowline
b) self-centering bowline
c) running bowline
d) clove hitch
e) half hitch
f) reef (square) knot
g) timber hitch
h) rolling hitch

4. Describe splicing of fibre and nylon ropes
5. Describe applications for short and long splice.
6. Identify side splice with an eye
7. Perform crown knot and back splice.
8. Describe and demonstrate the testing and strength reductions of knots and splices.

B. Hoisting Devices and Accessories ..... 8 Hours

Outcome: Apply safe work practices and procedures when using hoisting devices.

1. List and describe Mobile cranes.
   a) types of mobile cranes
   b) parts of a mobile crane
   c) parts of a crawler
   d) safe working practices
2. Demonstrate uses and safe working practices for hoisting devices.
   a) air hoists
   b) come along
   c) wire rope pullers (tirfor)
   d) chainfalls
3. Identify the function, advantage and limitations of various slings and sling arrangements.
4. Demonstrate slings and hitches used for hoisting materials.
5. Demonstrate the best practices for the use of slings and tag lines.
6. Demonstrate proper use and location of sling configurations on loads for hoisting.
   a) smooth heavy loads
   b) long flexible loads
   c) off balance loads
   d) heavy fragile units
   e) finished or coated loads
7. Determine the centre of gravity for different types of loads.
8. Perform all operations in accordance with the manufacturers specifications or the specifications certified by a professional engineer

C. Hoisting Communication ..... 4 Hours

Outcome: Identify and demonstrate the safe use of hoisting communication.

1. List and demonstrate hand signals used for moving equipment and hoisting.
2. Describe methods and precautions in using hand signals.
3. Describe and demonstrate voice communications
   a) radio (2 way and walkie talkie)
   b) current technology
4. Describe precautions used in voice communication.

D. Wire Rope and Attachments.....10 Hours

Outcome: Identify and perform basic rigging skills using wire rope and attachments.

1. Define and describe wire ropes
   a) types of steel used for wire ropes
   b) lays and their advantages
   c) wire rope cores
   d) four basic classifications of wire ropes
   e) working load limits (W.L.L.)
   f) wire rope faults and removal criteria
   g) care and handling of wire rope
2. Define, describe and demonstrate the ability to apply material handling attachments.
   a) hooks and shackles
   b) wire rope clips
   c) eyebolts
   d) chain
   e) additional Industry attachments
3. Determine and calculate the working load limits (WLL).
4. Use tables and charts for wire rope and attachments.
5. Perform all operations in accordance with the manufacturers specifications or the specifications certified by a professional engineer

SECTION THREE: ..... INTRODUCTION TO DRAWINGS AND LAYOUT ..... 58 HOURS

A. Basic Materials.....12 Hours

Outcome: Identify and demonstrate basic material knowledge.

1. Identify all structural shapes and their respective designations.
2. Describe the parts of structural shapes as per their designations.
3. Explain actual and nominal dimensions.
4. List the information required when ordering wide flange beams.
5. Define the terms camber and sweep.
6. Define the classification of steel plate with reference to thickness and width.
7. Explain the purpose and applications of clad steel and other cladding materials.
8. Identify welded bar grating types used for stairways and platforms.
9. Identify expanded mesh and expanded mesh grating by its standard sizing.
10. Interpret the designations for pipe and tube.
11. Explain the difference between material designations for common pipe grades (such as A53 A120, A106).
12. Perform pipe cutting to size using a pipe cutter and/or oxy-fuel cutting process.
13. Describe cutting/threading of pipe using manual and mechanical process.
14. Describe fixed and aligning threaded fasteners.
15. Define bolts, studs and screws

16. Describe bolt grading and sizing as designated by SAE and ASTM.
17. Interpret nut and bolt markings to determine physical properties and type of material.
18. Determine the bolt threads length for bolts and screws up to 6 inches in length.
19. Determine the wrench sizes with related reference to the bolt major diameter.
20. Describe standard fittings, their sizing, designation and function:
    a) nozzles
    b) couplings
    c) tees
    d) elbows
    e) flanges (including slip-on and weld neck)
    f) blind flange
    g) blanking plates
    h) plugs
    i) valves (backflow, check)
21. List the pressure ratings used for forged steel flanges.

B. Material Preparation and Assembly ....8 Hours.

Outcome: Describe and demonstrate material preparation skills.

1. Explain and describe the layout procedure for marking-up of the following:
    a) cutting
    b) braking
    c) shearing
    d) rolling
    e) drilling
    f) punching
2. Describe the purpose of templates:
    a) materials used to make templates
    b) types of templates
3. Identify the following templates:
    a) bending (sweep)
    b) marking (gusset plates)
    c) pattern (pipe turns)
4. Describe methods used to identify fabricated components and assemblies.
    a) item numbers
    b) material identification
    c) job and contract numbers
    d) erection sequencing

C. Basic Drafting ..... 20 Hours

Interpretation and correlation of information found on multi-sheet complex prints, including material, identification on parts, orientation and layout of structure or parts of a structure utilizing to the fullest actual working prints on vessels, tanks, precipitators and boilers.

Outcome: Identify the basic knowledge of drawing interpretation.

1. Demonstrate the ability to draw a sketch.
2. Properly fold and protect drawings for immediate and future use.
3. Interpret symbols and abbreviations as required.
4. Identify line types and uses.
5. Identify the correct placement of dimensions applying the unidirectional system.
6. Identify the common parts of a drawing and the information contained within them.
7. Define the principle of orthographic projection.
8. Explain the principle and applications of an isometric projection.
9. Identify section views and their application.
10. List three types of sections.
11. List two requirements for a multi-view projection.
12. Give examples of parts that need one or two views only.
13. State the difference between primary and secondary auxiliary views.
14. Define the right and left hand views.
15. Identify the advantages for using partial views.
16. Interpret symbols and abbreviations on drawings compiled from standards used on the following components:
    a) materials preparation
    b) structural and plate
    c) fired and unfired pressure vessels
    d) tanks
    e) heat exchangers
    f) precipitators
    g) others used in industry
17. Interpret and apply welding symbols and abbreviations.
    a) weld
    b) supplementary symbols
    c) specifications
    d) groove and weld dimensions
    e) contour
    f) method of finish
    g) single and double breaks in arrow line
    h) standard rules for reading welding symbols
    i) location of symbols on drawings

D. Introduction to Layout ..... 18 Hours

Outcome: Perform basic layout skills.

1. Identify, select and use measuring, checking and layout tools.
   - a) various types
   - b) standard features
   - c) design characteristics
   - d) maximum obtainable accuracy
   - e) applications
   - f) correct method of use
   - g) correct handling
   - h) storage and maintenance procedures
   - i) required conditions of use
2. Perform the following geometrical constructions:
   - a) construct a line segment equal to a given line segment
   - b) construct an angle to a given angle
   - c) bisect a given angle, layout 45, 60, 30 degree angles
   - d) construct a line perpendicular to a given line through a given point on the line
   - e) bisect a given line segment
   - f) construct a line perpendicular to a given line through a given point outside the line
   - g) construct a line parallel to a given line through a given point
   - h) construct a tangent to a given circle through a given point on the circle
   - i) divide a line segment into any number of equal parts
   - j) circumscribe a circle outside a triangle
   - k) locate the centre of a given circle
   - l) inscribe a circle in a given triangle
   - m) construct regular polygons with any number of flats
   - n) inscribe and circumscribe regular polygons
   - o) layout an angle
   - p) inscribe a given radius into right angle, acute angle and obtuse angle turns
   - q) bisect a given arc
   - r) construct an ellipse using the trammel method
3. Describe the pattern for a rectangular piece of ducting cut at an angle using parallel line development.
4. Develop a pattern for a two-piece 90-degree elbow using parallel line development.
5. Develop a layout for the geometric construction of bolt circles, manholes, flanges and ellipses.

SECTION FOUR: ..... WELDING AND CUTTING ..... 50 HOURS

The welding instruction under this section shall not be to the level of a proficient and skilled Welder. The intent is to train the potential apprentices to a level where they may operate the required equipment in a safe manner, and perform such operations of metal cutting and welding as to make temporary attachment of component parts, prior to the finish welding required by a certified Welder.

A. Electric Arc Welding ..... 25 Hours

Outcome: Identify and demonstrate the basic use of electric arc welding equipment.

1. Describe and demonstrate the use of safety equipment and follow manufacturers specifications

a) welding apparel
b) protective screens
c) welding helmet and illustrate the proper placement of lenses
d) harmful rays and fumes and their effects
e) grounding of electrical equipment

2. Maintain safe work environment.
3. Define electricity as it relates to welding.
   a) open circuit voltage
   b) arc voltage
   c) alternating current and direct current
   d) resistance
   e) duty cycle
   f) reverse and straight polarity
   g) heat distribution using reverse or straight polarity
   h) voltage loss
4. Describe basic arc welding machines:
   a) components and operation of an alternating current transformer
   b) components and operation of AC-DC rectifier
   c) components and operation of an AC and DC generator
   d) mulit-process inverter welding power source
   e) advantages and disadvantages of the various types of welding machines
5. Explain maintenance required for welding machines.
6. Describe welding machines accessories:
   a) cable construction
   b) cable sizing
   c) various types and sizes of electrode holders
   d) cable lugs, quick connectors and ground clamps
7. Explain the numerical definitions of electrodes and heat settings.
8. Demonstrate the ability to weld stringer beads on available mild steel in the flat position using E4310 (E6010) and E4918 (E7018)
9. Identify common weld faults.

B. Oxy-fuel Cutting ..... 25 Hours

Outcome: Safely use oxy-fuel cutting equipment.

1. Describe and demonstrate the use of safety equipment and follow manufacturers specifications.
   a) apparel
   b) protective screens
   c) goggles, face shield, filter lenses
   d) harmful rays and fumes and their effects
2. Maintain a safe work environment.
3. Identify and describe oxy fuel cutting equipment.
4. Identify the characteristics of oxygen and fuel gas cylinders.
5. Describe the different sizes of cylinders.

6. Explain the procedure for handling, transporting and storing cylinders.
7. State the procedure for handling faulty cylinders.
8. Explain the construction and purpose of a manifold system.
9. Identify and select correct fuel gases for manual and automatic flame cutting of carbon steel.
10. Identify and describe regulator types and purposes.
11. Demonstrate the correct adjustments and care of regulators.
12. Describe the construction and maintenance of hoses and fittings.
13. Describe the design, maintenance, selection and operation of oxy-fuel tips.
14. Explain and demonstrate the set-up of oxy-fuel equipment.
15. Explain the correct procedure in checking for leaks.
16. Define the principle of the oxy-fuel gas cutting process.
17. Explain and demonstrate the setting of oxy-fuel pressures, balancing and flame adjustments.
18. List the causes of backfires and flashbacks.
19. Define flame propagation.
20. Demonstrate the ability to light a torch using the recommended striker.
21. Explain and demonstrate the different types of flames and uses.
22. List and demonstrate the acceptable shutting down procedure.
23. Explain and demonstrate fire prevention and controls.
24. Identify the types of fire extinguishers available and where used.
25. Define hazardous areas in construction.
26. Perform manual cutting on material of various thickness:
    a) straight line and bevel cutting on plate steel
    b) cuts on various structural steel shapes
    c) circle cutting
    d) hole piercing
    e) radial cutting
27. Describe expansion and contraction.
28. Describe how to control expansion contraction and distortion resulting from, welding and cutting.

SECTION FIVE:..... TRADE KNOWLEDGE ONE ..... 60 HOURS

A. Mathematics .....20 Hours

Mathematics has been determined as being an integral component of the technical training when it is applied in the strictest terms of trade involvement specifically being totally related. Due to the nature of application in the trade of Boilermakers, the mathematics given under this section shall be flexible and applied to the work where feasible.

Outcome: Solve mathematical problems.

1. Fractions (120104a)
    a) Identify key terms and concepts used in working with fractions.
    b) Change fractions to a common denominator.
    c) Solve problems using whole numbers and fractions.

d) Solve problems using whole numbers and fractions in practical applications.
e) Solve squares and square roots.

2. Decimals (120104b)

a) Read and write decimal fractions.
b) Round decimal fractions to specified place values.
c) Convert decimal inches to a fraction with a practical denominator.
d) Convert decimal feet to feet and inches with a practical denominator.
e) Convert fractions to decimals.
f) Add and subtract decimal fractions.
g) Multiply and divide decimal fractions.

3. Metric and Imperial Measurement (120104d)

a) Identify commonly used metric units of measurement.
b) Convert between units of measurement.
c) Convert imperial units: feet to inches, square inches to square feet, and cubic measures to gallons.

4. Solve simple arithmetic problems by applying the principles of:

a) whole numbers
b) decimal numbers
c) fractional numbers
d) mixed numbers

5. Using linear measurements compute perimeters of the following shapes:

a) rectangles
b) squares
c) triangles
d) circles

6. Solve Basic linear measurement problems using the Imperial and Metric measurement systems:

a) calculate length
b) calculate weights and capacities
c) calculate area
d) calculate volume
e) express units of area measure
f) express units of volume measure
g) perform combining calculation on practical applications using various units of measure
h) calculate conversions from Imperial to Metric and visa versa

B. Hand and Power Tools .....16 Hours

Outcome Identify and use tools safely.

1. Recognize safety hazards related to general safety.
2. Perform all operations in a safe manner in accordance with the Health and Safety Act, manufacturer's specifications and the rules and regulations of specific facilities.
3. Identify, illustrate and describe the safe operation and maintenance of hand tools.

a) spirit level
b) plumb bob

c) hammers
d) chisels
e) drill bits
f) pliers
g) clamps
h) bolt cutters
i) hacksaws
j) files
k) punches and pins
l) connecting bars
m) bull pins
n) line up bars (drift pins)
o) punches
p) sliding t bevels
q) various types of squares
r) scribers
s) dividers
t) chalk line
u) vises
v) trammel points
w) measuring tools
x) removal of mushroomed or fractured heads on chisels, punches and stamps

4. Identify, illustrate and describe the uses of wrenches:

a) structural offset (spud wrench)
b) sockets, ratchets and drives
c) adjustable
d) combination
e) open end
f) box end
g) set screws
h) torque
i) pipe

5. Describe and demonstrate the safe operation and maintenance of power and pneumatic tools:

a) hand drills
b) grinders
c) pedestal grinders
d) chipping hammers

6. Describe mounting procedures for grinding wheels on a pedestal and portable grinder.

7. Demonstrate the safe use of a disc grinder.

a) Disc selection
b) clean torch-cut edges
c) remove tacks/scabs
d) cut material
e) wire brush (remove layers of paint, rust, etc.)
f) regrind chisels, punches, screw drivers and drifts to the correct size and geometry
g) buff surfaces

8. Safely and efficiently operate pneumatic and/or electrically powered portable and stationary drilling equipment.

9. Identify and use twist drills.
10. Use and maintain threading equipment for the production of internal and external threads.

C. Metallurgy..... ..8 Hours

Outcome: Identify and demonstrate the basic knowledge of physical and mechanical properties of metal.

1. List and describe the six elements that are always present in steel.
   a) carbon
   b) manganese
   c) sulphur
   d) silicon
   e) iron
   f) phosphorus
2. Describe the effects of carbon and the other elements in steel.
   a) physical properties
   b) weld ability
3. Differentiate between ferrous and non-ferrous metals.
4. Describe the production of cast iron, carbon steel, alloy steel and stainless steel.
5. Describe killed steel.
6. Describe the forming of steel from the ingot stage to the finished product for:
   a) plate
   b) sheet
   c) bar
   d) rod
   e) tube
   f) rail
   g) pipe
   h) structural shape
   i) forging
7. Define the mechanical properties of plain carbon steel:
   a) stress
   b) strain
   c) elasticity
   d) ductility
   e) toughness
   f) yield point
   g) yield strength
   h) tensile strength
   i) compression strength
   j) elastic limit
   k) brittleness
   l) malleability
   m) impact strength
   n) elongation
   o) torsion strength
8. Define the physical properties of plain carbon steel:

a) color
b) melting point
c) density
d) heat and electrical conductivity
e) corrosion resistance

9. Name the four basic types of carbon steel.
10. Name the five groups of steels.
11. Explain how the amount of carbon in ferrous material determines whether a material is steel or a cast iron.
12. Explain how low-alloy, high-tensile steels differ from low carbon steels.
13. Determine the main advantage of low-alloy steel.
14. Describe the significance of AISI steel numbers.
15. Describe the application of different types of steel for a specific uses.

D. Trade Related Components .....8 Hours

Outcome: Identify trade related components.

1. Identify and describe pressure vessel components and their functions:
   a) heads (elliptical, dished and hemispherical)
   b) courses shells and baffels
   c) manways
   d) davits
   e) trays, downcomers
   f) weirs
   g) hand holes
   h) repads
   i) skirts and saddles
   j) demisters
   k) vortex breakers
   l) catwalks and ladders
   m) plug
2. Define mounting of a Davit for both vertical and horizontal openings.
3. Describe the shapes and minimum standard dimensions of hand hole openings.
4. Determine the minimum diameter used for a circular manway opening as per CSA.
5. Explain the use of a bubble caps and tray fittings.

E. Identification of Pressure Vessels.....8 Hours

Outcome: Demonstrate the basic knowledge of pressure vessels, tanks and boilers.

1. Identify the boilermaker's involvement in the following heavy industrial sectors:
   a) nuclear generating stations
   b) hydro generating stations
   c) fossil fuel generating stations
   d) oil refineries
   e) pulp and paper mills
   f) steel plants

2. Identify types and explain the working principles of watertube boilers and firetube boilers.
   a) describe shell and tube sheet construction
   b) identify boiler tubes
   c) describe the function of a firebox
   d) explain the purpose of stays and buckstays
   e) describe the scope and limitations of ASME boiler and pressure vessel code
   f) identify platforms, ladders, walkways and other typical structures related to boilers
3. Describe the working principle of heat exchanger and their components.
4. Explain heat exchanger sizing and type designation.
5. Describe the working principle of distillation towers and their components.
6. Describe the working principle and types of storage tanks and their components.
7. Identify procedures, safe work practices and equipment used in basic tank erection.

SECOND YEAR TECHNICAL TRAINING
BOILERMAKER TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

SECTION ONE:.....RIGGING TWO ..... 52 HOURS

A. Block and Tackle ..... 20 Hours

Outcome: Demonstrate and identify knowledge of block and tackle systems.

1. Demonstrate or describe best work practices when reeving:
   a) square
   b) skip
   c) tandem
   d) equalizer sheaves
   e) lacing
   f) reeving of simple and multi-blocks up to 24 parts
2. Calculate the mechanical advantage of block and tackle systems.
3. Determine the working load limits that can be lifted with a given rigging arrangement.

B. Wire Rope Drums ..... 6 Hours

Outcome: Demonstrate the working knowledge of wire rope drums.

1. Describe the fleet angles required for grooved and smooth drums.
2. Determine drum capacity.
3. Describe and demonstrate spooling procedures.

C. Lifting Practices.....20 Hours

Outcome: Demonstrate the ability to apply best practices for lifting.

1. Apply the W.L.L. for various load and sling configurations.
2. Use table and charts for rigging.
3. Demonstrate the knowledge of signals.
4. Basic knowledge of fork truck operations.
5. Define the sling tension formula.
6. Lifting devices.
   a) spreader bars
   b) balance beam
   c) load levelers

D. Aerial Access Equipment and Scaffolds ..... 6 Hours

Outcome: Describe the safe use of scaffolds.

1. Describe the set-up of all temporary work platforms.
   a) plank inspection
   b) plank placing and securing
   c) ladder
   d) swingstage scaffolding
   e) suspended scaffolding
   f) needle beams
   g) modular platform
2. Describe the safe use and pre-operational check of aerial work platforms.

SECTION TWO: ..... DRAWINGS AND LAYOUT ..... 66 HOURS

Outcome: Demonstrate the ability read drawings and perform layouts.

This section consists of lectures and supporting shop practices on the progressive preparation of materials in the proper sequence to successfully fabricate a small project beginning with the print and selection of materials to the finished project.

A. Drawing Interpretation ..... 24 Hours

Outcome: The ability to interpret drawings.

1. Demonstrate drawing interpretation skills.
   a) vessels
   b) tanks
   c) boilers
   d) trade specific components

B. Layout and Fabricating ..... 42 Hours

Outcome: Demonstrate the knowledge of layout, fabrication practices and procedures.

1. Ability to read a drawing and describe the component(s) used in the fabrication process.
2. List and describe the abbreviations applicable to plate layout and development.
3. Calculate practical problems on squares, rectangles and circles for transfer to the plate for development and fabrication.
4. Read a drawing; determine the materials required and layout the pattern on the plate.
5. Demonstrate the ability to utilize material through pre-planning and nesting.
6. Demonstrate the ability to select and use tools for layout.
7. Develop a pattern for a two and three piece 90-degree elbow using parallel line development.
8. Demonstrate the ability to develop a template using geometric construction parallel lines and radial line development.
9. Layout and fabricate components from drawings.
   a) ladders and platforms
   b) a davit for vertical and horizontal opening
   c) a header

d) pipe turns and offsets
e) square ducts
f) cylinders and cones
g) pressure vessel shells

10. Perform radial nozzle installation.

SECTION THREE: ..... FITTING AND FABRICATION TWO ..... 66 HOURS

A. Cutting, Welding and Related Processes ..... 54 Hours

The welding instruction under this section shall not be to the level of a proficient and skilled welder. The intent is to train the apprentice to a level where he may operate the required equipment in a safe manner, and perform such operations of metal cutting and welding as to make temporary attachment of component parts, prior to the finish welding required by a certified welder.

Outcome: Demonstrate the safe use of cutting, welding and related process equipment.

1. Identify and describe forces involved in material expansion and contraction.
2. Describe cutting processes involved in cutting alloy steels and non-ferrous metals.
   a) plasma-arc
   b) water jet cutting
3. Describe correct cutting techniques and common cutting faults.
4. Perform flame cutting skills involving radial cuts.
5. Demonstrate flame-cutting skills on structural shapes.
6. Demonstrate weld joint preparation and joint tolerances from drawings.
7. Determine if metal conditions require specific cleaning methods.
8. List the functions of coating for arc welding electrodes.
9. List the functions of slag in arc welding electrodes.
10. Explain the effects of alloy additions to the coating for arc welding electrodes.
11. Explain static and dynamic loading for arc welding electrodes.
12. Describe the storage requirements of low hydrogen electrodes.
13. Explain the reasons for selecting a welding machine for a specific task.
14. Recognize these other welding processes, GTAW, GMAW, FCAW and SAW.
15. Demonstrate the set up and operation of (carbon arc cutting) CAC-A equipment correctly and safely.
16. Determine the correct fit up and procedure for welding operations.
    a) joint spacing
    b) holding or clamping devices
    c) number and spacing of tack welds
    d) pre-setting/distortion allowances of joint member current type, polarity and voltage
17. Interpret welding symbols as standardised by the American Welding Society specific to this trade for shop and field construction.
18. Demonstrate the ability to weld a lap joint in the 2F (horizontal) position using E4310 (E6010) and E4918 (E7018).
19. Demonstrate the ability to weld a tee joint in the 2F (horizontal) position using E4310 (E6010) and E4918 (E7018).

20. Demonstrate the ability to weld a corner joint in the 1F (flat) position using E4310 (E6010) and E4918 (E7018).

21. Demonstrate acceptable welding procedures to prevent distortion, etc. for all the joints.

B. Fibreglass Fitting.....12 Hours

Outcome: Demonstrate the best work practices related to fibre reinforced plastics.

1. Perform the skills required to safely handle and store the chemicals required to assemble fibreglass pipe.
2. Identify skills required to install fibreglass fittings
   a) drawing interpretation
   b) drilling
   c) bolting
   d) resin production and handling
   e) cutting
   f) grinding
   g) laminating glass
3. Identify and describe the resins and fibreglass materials required for lay-up and repairs.
4. Describe the uses of fibreglass in pulp mills, chemical plants and refineries.
5. Describe where boilermakers use fibreglass in tanks, silos, stacks breeching and piping.
6. Define the purpose of fibreglass materials.
   a) polyester resins
   b) catalysts
   c) promoters
   d) surfacing veil
   e) mat
   f) woven roving
   g) acetone
   h) methylene chloride
   i) air dry additive
7. Perform the skills required to facilitate repairs on round and flat surfaces.
8. Describe the tools and materials used for preparation and assembly:
   a) power cutter (skill saw)
   b) power disc sander
   c) extension cords
   d) rags
   e) wax paper (feeler wrapper)
   f) rubber gloves
   g) paper coveralls
   h) face shields
   i) safety goggles
9. Describe measuring equipment:
   a) paper or plastic mixing cups
   b) mixing sticks
   c) plastic bucket graduated for measuring resin
   d) glass for measuring promoters and catalysts
   e) mixing pails

10. Describe lay-up equipment:
    a) surfacing veil
    b) matting
    c) woven roving

11. Describe procedures and/or equipment for fibreglass lay-up.
    a) tight fit-up
    b) sanding
    c) filler
    d) saturate mat
    e) stagger cut lengths
    f) mix resin and catalyst
    g) apply surface veil
    h) remove air
    i) sand entire weld
    j) apply resin and air dry mix
    k) heat lamps
    l) application method
    m) hand lay-up
    n) spray lay-up
    o) cutting, fitting and surface preparation
    p) outside joint (structural)
    q) inside joint (liner)

SECTION FOUR: ..... TRADE KNOWLEDGE TWO ..... 55 HOURS

A. Mathematics ..... 18 Hours

Outcome: Solve mathematical problems.

1. Compute squares and square roots of numbers.
2. Apply square roots calculation in solving right angle triangle problems using Pythagorean Theorem.
3. Compute area of flat planes:
    a) squares
    b) parallelograms
    c) triangles
    d) rectangles
    e) circles
    f) sectors
4. Solve problems involving percentages.
5. Solve Intermediate linear measurement problems using the Imperial and Metric measurement systems:
    a) calculate length
    b) calculate weights and capacities
    c) calculate area
    d) calculate volume
    e) perform combining calculation on practical applications using various units of measure.
    f) calculate conversions from Imperial to Metric and visa versa

B. Power Tools (Electric and Pneumatic) ..... 8 Hours

Outcome: Demonstrate the safe use of power tools.

1. Perform all operations in accordance with the manufacturer's specifications.
2. Demonstrate the use of the following portable power tools:
   a) drills and reamers
   b) tube expanders (identification only)
   c) impacts (wrenches and hammer drills)
   d) pipe threading and cutting equipment
3. Introduce bolt control equipment.

C. Instruments ..... 4 Hours

Outcome: Demonstrate the ability to use measuring instruments.

1. Basic understanding and set up of transits.
2. Demonstrate and transfer elevation points using a water level.
3. Demonstrate the skills and abilities in precision measuring using a micrometer (Metric and Imperial).
4. Introduction to new technologies.

D. Shop Equipment ..... 6 Hours

Outcome: Identify and demonstrate the safe use of shop equipment.

1. Perform all operations in accordance with the manufacturer's specifications.
2. Describe the types of drilling machines.
3. List and describe set-up procedures for drilling machines.
4. Identify and describe drills and drilling tools.
5. Describe drill bit geometry and its sharpening procedures.
6. Determine drilling speeds and feeds.
7. Set up a drill press and drill multi-diameter holes from 1/8" to 2" to an accuracy of 1/32".
8. Operate and maintain reaming equipment.
9. Describe the power roll operations for forming:
   a) a full cylinder
   b) a partial cylinder
   c) a cone (reducer)
   d) a partial and full ring
10. Determine roll and brake capacity and allowances and proper direction to roll or bend.
11. Calculate blank length before forming, including:
    a) bend allowance
    b) flat sections
    c) seam allowance, e.g. (root opening)
12. Describe how to perform the following operations on shearing and punching machines.
    a) set up and punch holes in plate, angles, channels and beams

b) shear angles at 45° and 90°
c) shear flat bar, rounds and square bar
d) notch and cope plate and structural shapes
e) cut to an accuracy of 1/16" for length and within 2° for angle cuts

13. Describe power press brake operations to form:

a) 90 degree bends
b) oblique angle bends
c) a half cylinder
d) a half cone (reducer)
e) a partial section square to rotated square
f) a partial section of square to round

14. Determine the correct methods of positioning dies for specific operations.

15. Describe the following power saws:

a) horizontal and vertical band saws
b) power hack saws
c) cold saws

E. Metallurgy ..... 10 Hours

Outcome: Identify and demonstrate the basic knowledge of physical and mechanical properties of metal.

The areas under this section shall be kept at a level of reasonable understanding by the apprentice and shall be of useful knowledge readily applicable to their work. The intent is not to advance to a metallurgist status but rather acquaint the apprentice with knowledge applicable to a working understanding of metal properties.

1. List the basic mechanical and physical properties of metals.

2. Identify the following metals:

a) white cast iron
b) gray cast iron
c) low carbon steel
d) high carbon steel
e) chromium-nickel steel (stainless)
f) high manganese steel
g) copper
h) aluminum

3. Determine the hardness of metal by using a file and compare to the Brinnell hardness scale.

4. Describe how welding (heating) influence the internal structure of steel.

5. Describe how welding and heating causes distortion.

6. Describe methods of preventing, controlling and correcting distortion including:

a) welding procedure
b) peening
c) grooving and re-welding
d) straightening
e) clamping and stress relieving
f) welding on opposite side
g) local heating, etc.

7. Determine the effect of carbon in its relationship to the weldability and flame cutting of steel.

8. Determine the effect of alloys in their relationship to the weldability and cutting action in steels.
9. Describe or demonstrate heat straightening.
   a) plate
   b) pipe
   c) distorted header
   d) distorted structural member
10. Explain the effects of hot and cold working metals.
11. Describe the changes to mechanical and physical properties of metals after hot and cold forming.

F. Heat Treatment..... 10 Hours

Outcome: Demonstrate the knowledge of material designations and the effect of heat on metals.

1. Describe the following terms
   a) hot rolled
   b) cold rolled
2. Describe the following designations of carbon steel materials.
   a) ASTM A-36 A-283 A-285 A-515 A-516
   b) CSA G40.20/21M Standard
   c) AISI System
3. Interpret the AISI system for designating stainless steels Series 200,300 and 400.
4. Describe and identify the heat effected zone (HAZ).
5. List four advantages in preheating of carbon steel for metal arc welding.
6. Identify effects and processes of the following heat treatments:
   a) expanding and shrinking
   b) stress relieving
   c) annealing
   d) hardening and tempering
   e) normalizing
   f) preheating
   g) post heating
7. Describe post-weld heating (stress relieving) as a means to:
   a) relieve stresses
   b) improve toughness
   c) increase strength and durability
8. Describe measures to control and check temperatures during preheating and postweld heating.
9. Describe the influence of the following on the micro-structure of the weld area (HAZ):
   a) the rate of heating
   b) the time at temperature
   c) the rate of cooling

THIRD YEAR TECHNICAL TRAINING
BOILERMAKER TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

SECTION ONE:.....RIGGING THREE ..... 35 HOURS

A. Advanced Block and Tackle ..... 12 Hours

Outcome: Demonstrate the ability to use Block and Tackle.

1. Determine the lead line pull when the number of parts and load weight including rope size are known.
2. Identify the factors that determine the amount of wire rope needed for a reeving system.
3. Name three types of sheaves, friction bearings and the coefficient of friction expressed in percent.
4. Demonstrate the ability to raise and lower a load using a reeved system.

B. Advanced Cranes ..... 10 Hours

Outcome: Identify and demonstrate the knowledge of cranes and signals.

1. Demonstrate or describe the following items related to cranes:
   a) general uses
   b) use of tables/load charts
   c) load radius
   d) boom deflection and pendant line stretch
   e) net and gross loads
   f) static and dynamic loads
   g) signals
   h) components
   i) breakdown for transportation
   j) safety precautions
2. Determine the basic procedures for the crane boom assembly, installation, removal and disassembly.
3. Determine the positioning of all pins at boom assembly.
4. Describe and determine load reduction when jib is fitted on the boom.
5. Determine in degrees the jib offset allowance in reference to the centreline.
6. Describe the implications when a crane is out of level.
7. Identify high capacity cranes and new technologies

C. Hoisting and Jacking Equipment..... 10 Hours

Outcome: Describe and demonstrate the safe use of hoisting and jacking equipment.

1. Describe the safe use of hoisting and jacking equipment.
2. Explain load stress and precautions in the use of high lines.

3. Perform rigging, hoisting and jacking operations in a safe and responsible manner.
4. Rig loads safely and correctly for:
   a) straight lifts
   b) drifting
   c) turning
5. Determine the location and anchorage points required for tuggers.
6. Identify the air system requirements for tuggers.
7. Describe the placement of blocks in a tugger hoisting system.
8. Demonstrate the ability to perform a walk around inspection in a tugger system.
9. Identify different jacking systems
   a) Hydraulic
   b) Mechanical
   c) Air bags
   d) New technologies
10. Describe and/or demonstrate the use of skates, rollers and cribbing.

D. Engineered Lifts..... 3 Hours

Outcome: Interpret engineered lift drawings.

1. Demonstrate the ability to interpret engineered lift drawings.
2. Identify the requirements and regulations for a critical lift.
3. List the topics discussed in prelift / postlift meetings.

SECTION TWO:..... ADVANCED DRAWINGS AND QUALITY CONTROL ..... 35 HOURS

A. Drawing Interpretation ..... 5 Hours

Outcome: The ability to interpret drawings.

1. Interpret fabrication and erection drawings for the following:
   a) Vessels
   b) Tanks
   c) Boilers
   d) Structural steel
   e) Heat exchangers
   f) Precipitators
   g) Duct work
   h) Other heavy industry components

B. Testing of Materials..... 10 Hours

Outcome: Describe material testing.

1. Differentiate between destructive (DT) and non-destructive testing (NDT) of material
2. Describe the following types of destructive testing:
   a) tensile test
   b) impact test

3. Describe the guided bend test used in weld testing.
4. Describe the following types of non-destructive testing:
   a) visual
   b) magnetic particle
   c) radiographic
   d) ultrasonic
   e) dye penetrate
   f) hydrostatic
   g) vacuum and air
5. Perform a dye penetrate test on defective materials.
6. Perform magnetic particle testing on defective materials.
7. Describe applications and limitations of vacuum and air testing.
8. Perform visual inspection on a welded specimen and summarize the results.

C. Inspection ..... 10 Hours

Outcome: Perform basic inspection practices.

1. Inspect and interpret material and welds with reference to:
   a) soundness, size and shape
   b) plate thickness and prescribe quality of material
   c) positions of circumferential and longitudinal seams
   d) heads, their opening and reinforcement
   e) skirt, diameters and minimum thickness
   f) base rings and anchor bolt chairs
   g) saddles,
   h) shell openings, limitations and reinforcement
   i) fixed and removable internals
   j) internal/external piping and flanges
   k) ladders, platform and lugs
   l) all fabrication tolerances
2. Identify the characteristics of acceptable quality of components and parts based on:
   a) code specifications
   b) drawing requirements
   c) general usage
3. List the factors contingent to production flow in fabrication and assembly of pressure vessels.
4. List three stages of a product quality control systems.
   a) incoming inspection
   b) in-process inspection
   c) final inspection
5. Describe methods that can be used to improve production and productivity of fabrication processes.
6. Describe the preparation for shipment of a final product with respect to the following components:
   a) finished inside and outside surfaces
   b) flanged openings
   c) threaded openings

d) bolts and nuts
e) small parts and loose internals
f) loading and securing the vessel
g) markings and special instructions

D. Business Practices ..... 10 Hours

Outcome: Apply basic worksite business practices.

1. Identify the purpose of the following general work related documents:
   a) invoices
   b) work orders
   c) purchase orders
   d) shipping and receiving slips
   e) requisition orders
   f) time keeping and payroll, cheques
   g) project progress reports
2. Demonstrate coaching and mentoring skills.
3. Demonstrate effective listening and speaking skills.
4. Plant tours (choice of some of the following):
   a) steel fabrication shops (vessel and structural)
   b) rolling mills (available types)
   c) operational job sites (with permitting authority)
   d) foundries (when and where time permits)
5. Guest speakers:
   a) unions
   b) management
   c) apprenticeship and trade certification
   d) industry representatives
6. Define the role and mission of the labour union organization.
7. Describe various industry work environments.
8. Orientation to the Red Seal National Occupation Analysis.
9. Demonstrate Respect in the workplace.
10. Identify the value of diversity in the workplace.

SECTION THREE: ..... ADVANCED FITTING AND FABRICATION ..... 60 HOURS

A. Layout ..... 30 Hours

Outcome: Demonstrate the ability to perform advanced layout.

1. Interpret drawings to layout and fabricate square, round and elliptical holes.
2. Demonstrate the ability to develop and utilize a template using geometry, parallel lines, radial lines and triangulation.
3. Demonstrate the ability to develop a template for various objects made in the shop using the triangulation method:

a) oblique pyramid
b) oblique cone
c) square to round transition
d) round to square transition
e) square to rotated square transition
f) square to round oblique transition

B. Fitting ..... 30 Hours

Outcome: Describe and perform advanced layout and fitting techniques.

1. Describe and/or demonstrate the layout and fit up of the following:
   a) circumferential seams
   b) longitudinal seams
   c) shells of equal thickness
   d) shells of unequal thickness
   e) shells to heads
   f) reinforcing pads to nozzle and shell
   g) repads to heads
   h) nozzles, couplings and structural components to the shell and head
   i) vessel base ring and skirt openings
   j) absorbing tower trays and downcomers
2. Describe how to fabricate and assemble davit parts for vertical and horizontal openings including hinges.
3. Describe how to install a tangential nozzle.

SECTION FOUR: ..... TRADE RELATED KNOWLEDGE THREE ..... 110 HOURS

Special emphasis should be placed on procedures used in installation, shut-downs and emergency repairs and recognition of the time limitations of shut-downs and emergency repairs.

A. Mathematics ..... 10 Hours

Outcome: Solve mathematical problems.

1. Calculate the surface area of:
   a) regular shaped solids, tanks and cylinders
   b) pyramids and cones
   c) prisms and cylinders
   d) areas, radii, arc length, circumferences, central angles and diameters of circles
   e) altitudes and bases of common polygons
   f) circular sectors and segments
   g) common polygons, given bases and altitudes
   h) more complex figures consisting two or more common polygons
2. Calculate volume, capacity and weight of:
   a) prisms and cylinders
   b) pyramids and cones
   c) spheres

3. Solve advanced linear measurement problems using the Imperial and Metric measurement systems:

   a) calculate length
   b) calculate weights and capacities
   c) calculate area
   d) calculate volume
   e) perform practical application calculations using various units of measure
   f) calculate conversions from Imperial to Metric and visa versa

B. Boilers..... 30 Hours

The boiler print course should be complemented by boiler components and erection procedure practice, where suitable shop equipment and time will permit.

Outcome: Describe the basics of boilers and their components.

1. Describe erection and assembly procedures for the following Boiler components:

   a) structure
   b) drums
   c) headers
   d) tubes
   e) platens
   f) buck stays
   g) casing
   h) fire door
   i) super heater elements
   j) economizer
   k) air heater
   l) deaerator
   m) water treatment

2. Describe the working operation of a water tube boilers:

   a) Sub-critical
   b) Super critical

3. Identify and describe boiler tube installation procedures, for the following:

   a) preparation of tube sheets
   b) tube sizes
   c) tube material
   d) expanding limits
   e) fit up of tube
   f) tube bending
   g) seal welding
   h) tack tubes
   i) self feed expander
   j) retractive expander
   k) lubrication
   l) mandrels
   m) over rolling
   n) under rolling
   o) micrometers and gauges
   p) belling

q) ferrules
r) repairing leaks
s) testing

4. Identify the following steam generator components and state their function, material grade, and any special features:

a) drums and headers
b) platen and buckstays
c) super heater and reheater
d) economiser and air heater
e) deaerator
f) air ducts
g) stacks and breaching
h) condenser
i) fans, I.D. and F.D.
j) intake and discharge lines
k) precipitators
l) wet and dry electrostatic precipitators
m) stokers
n) burners
o) bag houses
p) scrubbers
q) selective catayalic reducers
r) air cooled condensers (ACC)
s) testing and codes
t) flue gas desulphurization units (FGD)

5. Describe the function of tubes in various arrangements.

a) bifurcated
b) swaged
c) bending

6. Identify the two basic methods used to fabricate tubes.

7. Determine the tube bending procedures with reference to:

a) long radius bends
b) short radius bends
c) very short radius bends (super heater section)
d) using field type equipment

8. List methods of tube attachments.

9. Describe basic procedures for watertube boiler tube installation including the preparation and cleaning process.

10. Explain the principle of tube expansion including the theory involving the flow of tube material.

11. Describe tube expanding procedures stating the upper and lower limitations of rolling.

12. List tube expanding checking and measuring devices used.

13. Define the purpose of tack tubes.

14. Identify the following tube expansion practices:

a) expanded and beaded
b) beaded and seal welded
c) expanded and welded

d) expanded and bevel welded
e) expanded and flared
f) prosser method
g) expanded with ferrules

15. Set-up and perform tube rolling operations.

16. Set-up and perform tube bending operations.

17. Set-up and perform tube installations and tube removals.

18. Describe and/or perform procedures for tube repair(s):

a) knowledge of Boiler code and local regulations
b) identify tube(s) to be repaired
c) mark tube(s) for cutting
d) cut out tube(s)
e) prevent tube blockage
f) prepare existing tube ends
g) prepare replacement tube(s)
h) fit and tack replacement tube(s)
i) variation of tube repair
j) window weld
k) appropriate preparation for different wall thickness

C. Condensers and Exchangers ..... 30 Hours

The condensers and exchangers print course should be complemented by erection and maintenance practice, where suitable shop equipment and time will permit.

Outcome: Identify and demonstrate the knowledge of condensers and exchangers.

1. Identify and describe different types of exchangers as listed below:

a) single pass
b) multi pass
c) split flow
d) double split flow
e) divided flow
f) cross flow
g) kettle type reboiler
h) plate

2. Identify different designs of heat exchangers as classified by the T.E.M.A. with reference to:

a) front stationary
b) rear head
c) types of material and job application
d) material designation
e) standard sizes and gauges
f) tolerances
g) fabrication and bending procedures

3. Explain the following terms which are associated with the tube hole arrangement:

a) circumferential pitch
b) ligament
c) pitch
d) removal space

e) longitudinal pitch
f) diagonal pitch

4. Set-up and perform tube rolling.

5. Identify baffle and tubes with respect to:

a) types of baffles, their function and installation procedures
b) four different tube sheet layouts and state their preference of application
c) pitch for a triangular tube sheet layout
d) various qualities of material for different applications

6. Explain the following types of heads:

a) channel and removable cover
b) bonnet
c) channel integral with tube sheet
d) pull through and floating head
e) outside packed floating head

7. Describe tube expanding procedures for condensers and exchangers:

a) tube sheet layout
b) number of tubes
c) type of metals
d) length of tubes
e) diameter of tube (O.D)
f) thickness of tubes
g) tube sheet or header thickness
h) expansion required
i) lubrication

8. List the basic steps associated with tube installation.

9. State the recommended tube expansion sequences with reference to tube sheet layout, its area and shape.

10. Demonstrate the ability to measure the inside diameter of a tube.

11. Demonstrate the ability to calculate the expanded diameter of a tube.

12. Demonstrate the ability to determine the percentage wall reduction as recommended for ferrous and non-ferrous materials.

13. List recommended lubricants.

14. Identify the optimum length of expanded seat.

15. Explain the reason for grooved seats.

16. Identify the factors affecting the quality of an expanded joint with reference to:

a) surface of hole
b) roundness of hole
c) cleanliness of hole
d) expansion past the inner edge of tube sheet
e) overheating
f) roller speed
g) mechanical properties of tube and tube sheet
h) lubrication or lack of it
i) over expansion and indication of it

17. Describe or demonstrate the ability to use the tube equipment listed:

a) tube guide
b) compressor
c) air motor
d) electric motor
e) tube end mills
f) tube expanders
g) fly cutters
h) tube cutters
i) tube cleaning
j) tube removal tools
k) micrometers and gauges
l) torque wrench

18. Describe the operational relationship of the mandrel and rolls.
19. State the purpose of bell roll(s).
20. Identify the propulsive type of expander.
21. Explain the principle involving explosive tube expansions.
22. Perform tube expansions into tube sheet using air powered expander drives.
23. Perform tube flaring using flaring tools.
24. Describe the procedure to locate, remove, replace and test for defects when making repairs to exchangers.
25. Inspect for tube leakage involving removal of:
    a) cover or bonnet
    b) shell cover and floating head
    c) channel
26. Describe hydrostatic test of shell using test ring (on types S & T).
27. Remove the tube bundle, inspect and replace it.
28. Assemble the heat exchanger and perform proper stud tightening procedures.
29. Describe or demonstrate tube plug installation procedures.
30. Identify plug material compatibility related to the tube.
31. Identify the safety features associated with heat exchangers, testing, inspections and repairs.

D. Tanks ..... 30 Hours

This section will be complemented by the drawing interpretation unit. All tank components and erection practical will be preformed where possible and if time permits.

Outcome: Describe and demonstrate the knowledge of tanks and erection procedures.

1. Describe the differences of the following types of tanks:
    a) vertical and horizontal (cylindrical)
    b) closed top or open (vented)
    c) include code question -OHI
2. Identify and describe the different types of materials used to fabricate tanks:
    a) carbon steel
    b) alloy steel
    c) nonferrous metals
    d) gauges and plates

e) mesh and screen

3. Determine the plate standards used for shells and decks with reference to the API specification.
4. Distinguish between the scope of A.P.I. 650 and / or A.P.I.620 standard and tank repair code A.P.I. 651 or A.P.I. 653
5. State the general condition of tank foundation and list negative effects encountered during erection due to uneven surfaces.
6. Identify the typical horizontal, vertical and spherical type of tank settings.
7. Describe or demonstrate the uses of balance beams, knee braces, key plates, clamps, dogs and wedges, hickey bars, leaf springs, finger bars and pins, wedges and dogs, clamps and nuts as used in tank construction.
8. Identify the difference between a flat (butt or lap) floor, orange peel floor and a hopper floor.
9. Describe the steps in laying out flat tank floor.
10. Demonstrate the ability to layout and fit up at a typical flat bottom lap joint.
11. Describe the procedures involving minimum flat lap welding and flushing lapped plates.
12. Identify the type of welding and joint preparation for a tank bottom, shell and deck.
13. Identify the fit-up and welding sequence for vertical and horizontal seam.
14. Demonstrate the ability to prep, fit up and align tank horizontal and vertical seams.
15. Describe the layout procedure for key plate lugs on the shell plate sections.
16. Demonstrate the ability to layout shell plate with reference to the vertical seams staggering.
17. Demonstrate the ability to layout and erect typical tank scaffolding.
18. Demonstrate the ability to layout and erect the first shell ring.
19. Demonstrate the ability to erect and properly space the succeeding rings.
20. Demonstrate or describe the layout and fit up of the top angle.
21. Describe the following type of weld used on joining, roof to top angle, bottom to shell, shell to top angle.
22. Demonstrate or describe the layout and fit up a conical self supported roof.
23. Describe the difference between a cone roof, hemispherical roof and a floating roof.
24. Explain the following terms associated with floating roofs:
    a) hard top floater
    b) pontoon floater
    c) double-deck floater
25. Describe the environmental and economical advantages of closed top tank design.
26. Describe the layout and fit up of shell, roof and bottom openings for a given:
    a) manway
    b) cleanout
    c) water or fluid drawoff elbow
    d) drawoff sump
    e) inlet outlet
    f) overflow venting
    g) walkway, stairway and ladders
27. Describe how to test tank bottom, shell and roof using one or two of the approved methods.
28. Define visual and surface weld Inspection.

29. Differentiate inspection requirement for large and small tanks specified by the API.650 and API.620.

30. Describe cathodic protection.

31. Describe and/or demonstrate the complete tank erection procedures of the components listed:

    a) site preparation
    b) floor
    c) first shell ring
    d) succeeding rings
    e) top angle
    f) roof supports
    g) roof plates
    h) ladders, stairways and platforms, etc
    i) shell fittings
    j) testing and repairs if required

E. Introduction to Other Heavy Industry ..... 10 Hours

Outcome: Identify and describe other heavy industry.

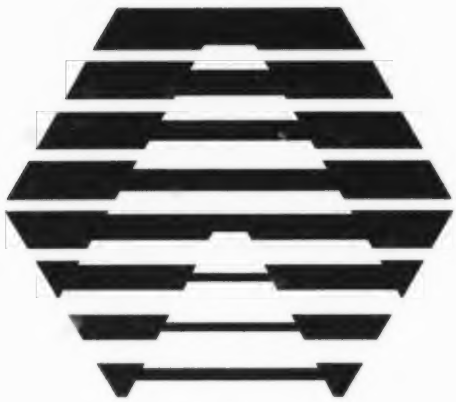
1. Describe the production of electricity by hydro generation
2. Identify the components in a hydro generating station.
3. Identify practices used in the erection of penstocks and surge tanks.
4. Identify the function of all components needed for the erection of penstocks and surge tanks:

    a) footings
    b) tie bars
    c) spiders
    d) tie straps

5. Describe nuclear generation.
6. Identify the components in a nuclear generating station.
7. Identify special procedures used when working on nuclear plants and components:

    a) problems specific to nuclear plants
    b) material which cannot be used
    c) difference in metals
    d) quality control
    e) special materials
    f) radiation
    g) radiation hazards
    h) weldment requirements
    i) expanding requirements

8. Describe the production of pulp and paper.
9. Identify the components in a pulp and paper mill.
10. Describe oil sand production.
11. Identify the components in oil sand production



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